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ABSTRACT

A meta-analysis considered the impact of various methods of improving public communication skills on critical thinking. Manuscripts were obtained by searching the available electronic databases (COMINDEX, Dissertation Abstracts, ERIC, Index to Communication Journals, PSYCHLIT), various bibliographies available on the topic, as well as the reference section of manuscripts obtained. Results indicated that communication instruction improves the critical thinking ability of the participants (longitudinal designs r = .176, cross-sectional designs r = .196). Forensic participation demonstrated the largest positive impact on critical thinking improvement, but all communication skill experiences demonstrate significant improvement. The cumulative evidence indicated that communication skill instruction generates, using the Binomial Effect Size Display (BESD), a 44% increase in critical thinking ability. This summary of available research provides documentation supporting the claims of departments and educators for the viability of communication skill instruction as a means of improving critical thinking. These results provide important evidence to support the maintenance of forensics programs in an era of increased educational accountability, downsizing, and budgetary cutbacks. (Contains 5 tables of data and 39 references.) (Author/NKA)

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Measuring the Impact of Forensics and Communication Education on Critical Thinking: A Meta-analytic Summary

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ABSTRACT

Measuring the Impact of Forensics and

Communication Education on Critical Thinking:

A Meta-analytic Summary

This meta-analysis considers the impact of various methods of improving public communication skills on critical thinking. The results indicate that communication instruction improves the critical thinking ability of the participants (longitudinal designs r = .176, cross-sectional designs r = .196). Forensic participation demonstrated the largest positive impact on critical thinking improvement, but all communication skill experiences demonstrate significant improvement. The cumulative evidence indicates that communication skill instruction generates, using the Binomial Effect Size Display (BESD) a 44% increase in critical thinking ability. This summary of available research provides documentation supporting the claims of departments and educators for the viability of communication skill instruction as a means of improving critical thinking. These results provide important evidence to support the maintenance of forensics programs in an era of increased educational accountability, downsizing, and budgetary cutbacks.

Key Words: Critical Thinking, Meta-analysis, Forensics, Communication Education, Public Speaking, Mock trial, Individual Events.

One of the central arguments for instruction in public speaking, argumentation, persuasion, and debate is the belief that such training improves the critical thinking ability of the participants (for a complete discussion of the range goals of forensics, that would apply to other public communication instruction, see Hunt, 1994). Hill (1993) points out that demands for educational accountability require that forensics (as well as other communication courses) document to what degree those activities meet educational goals. The increasing need for university programs to provide "proof of service" creates a need for communication courses and activities to document the improvements generated. Such claims can be supported with testimonials, antedoctal stories, and examples from participants. However, systematic and more objective indications of improvement would provide an additional level of support more persuasive to some critics.

Garside (1996) surveyed the impact of group discussion teaching strategies on the development of critical thinking skills and concluded that:

> the literature suggests at least four defining aspects of thinking that make is *critical:* (a) thinking that is clear, precise, accurate, relevant, logical, and consistent; (b) thinking that reflects a controlled sense of skepticism or disbelief of any assertion, claim, or conclusion until sufficient evidence and

> reasoning is provided to conclusively support it; (c) thinking that takes stock of existing information and identifies holes and weaknesses, thereby certifying what we know or don't know; and (d) thinking that is free from bias, prejudice, and one-sidedness of thought (p. 215)

Instructors of public speaking, discussion, and argumentation as well as those advocating participation in competitive forensics, have argued that such activities improve critical thinking. Unbridled by the limitations found within the traditional lecture-oriented classroom situation, participants must learn to invent, organize, and articulate thoughts subject to scrutiny by others. The student learns not only how to generate higher quality thinking but learns how to critique the arguments and conclusions of others. The process of participation as a communicator originating the argument and as a critical consumer provides a "hands on" experience that should improve critical thinking ability.

Assuming that such improvement occurs, the conclusion is that the educational advantages of a person able to both generate and critique conclusions provides the basis for quality participation in the society and the academic environment. The conclusion offered is simple, participation in forms of public communication involved in public speaking, forensics (debate,

mock trial, individual events), and argumentation require attention to argument and counterargument.

Previous Research

There exists a number of investigations comparing the impact of various communication skill experiences on critical thinking (Colbert, 1995; Hill, 1993). Available research summaries provide at best a mixed set of support for the argument that experience with communication skill exercises, particularly forensics, provides a measurable improvement in the area of critical thinking (Follert & Colbert, 1983).

The typical investigation in this area takes some group of college students in a course (Allen, Berkowitz, & Louden, 1995; Hurst, 1962; Johnson, 1942; Ness, 1967) or a group of forensics participants (Allen, Berkowitz, & Louden, 1995; Bursack, 1961; Colbert, 1995) and compares the change over time in critical thinking or compares different groups. The concern of educators has prompted a series of investigations over the past fifty years exploring the impact of communication skill experiences on critical thinking.

One issue not considered is the number of unpublished reports of data that exist. A search of computer indexes (*ComIndex*) and the published literature finds relatively few data sets in existence. However, a number of unpublished doctoral dissertations (Beckman, 1955; Cross, 1971; Frank, 1964; Hurst, 1962; Jackson, 1961; Ness, 1967; Tame, 1958) and unpublished

master's theses (Baumgartner, 1965; Beihl, 1963; Bursack, 1961; Smith, 1942) exist. The inclusion or consideration of this set of information expands the available data base considerably.

The current data base is sufficient to justify the use of meta-analysis as a means of summarization. The next section of the paper considers various criticisms of the existing literature. If all the available research employed fundamentally flawed designs or measurement, than any proposed summary of the research is meaningless. It is only after the literature is accepted as relevant that any summary becomes useful.

Critiques of Existing Research

The largest single criticisms of research examining the impact of communication skills training on improvements in critical thinking usually consider two issues: (a) Measurement of critical thinking, and (b) Selection of samples used for analysis.

The Watson-Glaser tests (in all it's forms) represents the dominant form of measurement for critical thinking (for an example of the test see Watson & Glaser, 1951). The paper and pencil objective test uses a multiple choice format. The questions involve tests of five different critical thinking skills (inference, recognition of assumptions, deduction, interpretation, and evaluation of arguments). The test format is usually the use of an example and then some test of an implication that follows. The question is whether the person

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can, using the accepted rules of inference, understand the permissible conclusions, inferences that one can make from the example or available data.

The Watson-Glaser Test (1951) scores each answer as correct or incorrect. The methodological issue is whether one can measure critical thinking using an objective test and whether an objective test completely captures the domain of critical thinking. The test has a history of adequate reliability, the question is one of validity. Is the use of a paper and pencil test a "valid" measure of the concept under study. The answer to this depends on how the term "critical thinking" is applied. The Watson-Glaser test measures the ability of persons to follow the "rules" involved in various forms of reasoning. To the extent that one accepts the underlying rules, the test is valid. Considerable discussion exists about the adequacy of this measure and the underlying conceptual variable (see Greenstreet, 1993; Hill, 1993).

The issue of the Watson-Glaser test and the inadequacy of the available measurement remains a serious one and cannot be resolved by this meta-analysis in a satisfying manner unless a sufficient body of alternative research exists using other measures of critical thinking. But even then, the alternative measures, if they share the same conceptualization would only provide convergent validity.

The second issue raised deals with the use of forensics participants to measure critical thinking improvement or the impact of forensics participation on critical thinking (this could be extended to other communication skill experiences as well). The argument is that forensic participants are self-selected, and the choice to participate in competitive forensics might be related to higher levels of existing critical thinking. Basically, the comparisons of forensic participants to nonforensic samples is not a fair comparison because of the bias in self-selection. The argument is that any estimate of the impact of forensic participation must consider or remove the impact of this sample bias.

The argument mathematically is rather limited. The argument only applies to the use of cross-sectional designs. Longitudinal designs would be biased **against** demonstrating significant gains in forensic participants if this argument is true. The reason for that is the "ceiling effect." The ceiling effect is the term used to note that a group cannot improve very greatly if the score is already at the top of the scale. If the mean critical thinking score for forensic competitors is higher than the general population, an improvement score should be lower for forensic participants, the forensic participants simply have less room to improve than nonforensicators.

If the impact of the effect exists, the pattern of results should demonstrate a higher score for forensics participants in

cross-sectional designs. The change score in longitudinal designs should favor forensic participants. Again, this assessment can be made if there exist a variety of designs to make this comparison.

The arguments surrounding the validity of the existing designs rather than being accepted as fatal flaws, are flaws that potentially become the focus of assessment. The advantage of meta-analysis as a literature summarization technique is that the arguments about measurement and design become the sources and reason for conducting the analysis rather than a rejection of the conclusions.

Justification for Using Meta-analysis (Again)

A previous meta-analysis (Follert & Colbert, 1983) conclude that "the results of this analysis cast substantial doubt on the claimed relationship between debate training and critical thinking skill improvement" (p. 2). The conclusion derived from five studies indicates no significant correlation exists between participation in debate and subsequent critical thinking gains. The meta-analysis form Follert and Colbert used generated a set of 47 individual comparisons. Of the 47, 28 demonstrated a gain in critical thinking for debate while 19 did not. The conclusion they offer is that there is no consistent body of evidence for a gain in critical thinking skill.

The previous meta-analysis was conducted using a technique and did a binomial test of the results of individual

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significance tests. Unfortunately, the binomial test fails to consider the impact of Type II error and treats each trial as a separate outcome. The result is that the failure to achieve significance does not consider the impact of the separate incidence of Type II error for each sample. This form of meta-analysis has been eclipsed by the development of more sophisticated statistical forms of meta-analysis (particularly variance-centered forms, Bangert-Drowns, 1986.

The problem with the previous form was that the results of the previous analysis do not establish an average effect, instead the effort is made to create a common metric and then look for consistency among the results of individual significance tests. Rather than averaging effects, the analysis is conducted at the level of individual units and a vote-counting method still employed.

Methods

Literature Search

Manuscripts were obtained by searching the available electronic data bases (COMINDEX, DISSERTATION ABSTRACTS, ERIC, INDEX TO COMMUNICATION JOURNALS, PSYCHLIT), various bibliographies available on the topic (Colbert, 1995; Follert & Colbert, 1983; Hill, 1993) as well as the reference section of manuscripts obtained.

To be included in the analysis a manuscript had to meet the following conditions:

(a) contain quantitative data;

(b) some type of communication skill improvement exercise (this could be in the form of a course or participation in competitive forensics);

(c) some method of assessing critical thinking skill improvement (either using a cross-sectional or longitudinal design).

Coding of Study Features

Study features were coded as potential sources of moderating influences. If the average results of the investigations are variable, then the search for moderator variables (particularly design differences) could serve as an explanation for such inconsistencies.

Type of Research Design

The investigations included in this analysis used two types of research designs to estimate the impact of communication skill training on critical thinking improvement: (a) Longitudinal, and (b) Cross-sectional designs. Some studies used both types of designs and contributed to both sets of analyses. A longitudinal design is one where there are multiple measurements on the same set of participants. The measure of the effect is a comparison of the scores from the first time period (pre-test) to the scores at a later time period, after exposure to the communication skills material (post-test). The assumption is that improvement is based on the participation in the training program. The

change is the amount of improvement demonstrated between the two measurements.

The second type of design, cross-sectional, is a static design (invariably a post-test comparison) between one group participating in some type of communication skills training versus some group that did not. The design represents a classic quasi-experimental design of an experimental and control group. The assumption is that each group started at the same level and the longitudinal comparison illustrates the impact of the differential experiences for the two groups.

Type of Communication Skill Experience

The type of communication skill improvement approach differed both between and within investigations. The experiences involved competitive forensic participation as well as courses designed to improve the skill of the student in accomplishing some communication task. The longitudinal experience was coded into the following categories: (a) public speaking class, (b) argumentation, debate, and discussion class and (c) competitive forensics participation (this includes debate, discussion, individual events, mock trial, or other types of participative competitive events). The division represents the type of experiences available to the participant. The coding for individual studies is found in Table 2.

The cross-sectional comparisons were divided into three types of comparisons: (a) communication skill activity

(forensics, public speaking class, or argumentation class) to a control group, (b) a public speaking or argumentation class to forensics, and (c) an argumentation class (or "special" public speaking class that included a section on argumentation and debate) compared to a public speaking class.

The divisions between types of courses or activities based on content provides some type of assessment about whether a particular type of content would most improve critical thinking skills. Competitive forensics is often given academic credit and the provision for such credit is based on critical thinking improvement as well as skill at public presentation. Demonstrating the relative size of the improvements offered in critical thinking for each type of activity provides educators with information on what approach(es) can be expected to generate particular outcomes.

Statistical Analysis

The data were analyzed using the variance-centered form of meta-analysis developed by Hunter and Schmidt (1990) reflected in the computer programs META-COR (Hamilton & Hunter, 1990) and ATTEN (Hamilton & Hunter, 1991).[1] The technique takes the statistical information from investigations and converts the information to a common metric. The form recommended is the correlation coefficient. The estimates for each study are statistically transformed into a correlation. The conversion creates a common metric from each investigation

Transformed data are corrected for a variety of statistical artifacts and possible design limitations. Correction to the data for attenuated measurement or restriction in range is possible. This correction can consider the impact of selection artifacts that reflect the possibility of self-selection artifacts for debaters. The impact of both sets of conditions is to systematically **underestimate** the size of the effect (Allen, Hunter, & Donohue, 1989; Hunter & Schmidt, 1990). So these corrections serve to increase the size of the existing effect, not reduce it. The average effect is therefore slightly larger after the corrections and the estimate of the variance larger as well. Each table provides the corrected correlations (r') as well as the uncorrected correlations (r).

The transformed data are then averaged using a formula that weights each correlation by the corresponding sample size. The reason that a weighted average is used is that the assumption is that larger samples provide more accurate estimates of the population effect than do small samples. The level of type II error is less with larger sample sizes. A study using a small sample size has a larger amount of sampling error and is therefore a less accurate estimate of the population parameter. Weighting by sample size is a recognition of this variability in the accuracy of the estimate. A moderator variable produces subsets the comparison of the mean effect of each subset demonstrates differences between the groups.

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No data appears more than once in any particular subgroup although data sets are used in multiple subgroups. This creates a problem of the data lacking statistical independence. A Monte Carlo test of the impact of lack of independence demonstrates however, that estimates of both the mean and standard deviation are unaffected by this problem (Tracz, 1985).

Results

Overall

The comparisons in the overall analysis (as well as moderator analysis) considers the two basic types of designs (longitudinal and cross-sectional) separately. The results of the longitudinal designs illustrate that communication skill exercises improve critical thinking (average r = .176, var. = .010, k = 17, N = 2657. 95% Confidence Interval [C.I.] ± .124). Cross-sectional designs find that a communication skill exercise improves critical thinking (average r = .196, var. = .028, k = 13, N = 2395, 95% C.I. ± .291).

A comparison of the difference in the size of the correlations demonstrates that while the cross-sectional design is larger than the longitudinal design (d = .105), the difference is relatively small. The most important consideration is that the effects are both positive, indicating that critical thinking improved when either using a longitudinal or cross-sectional comparison.

Type of Critical Thinking Measurement Instrument

The studies fell into two basic groups: (a) studies that used some version of the Watson-Glaser Critical Thinking Appraisal (1951), or (b) some other measure of critical thinking. Table 1 provides a list of the measures used in each investigation. This analysis considers the longitudinal and cross-sectional data separately.

Analysis comparing those studies using a longitudinal design demonstrates that the studies using Watson-Glaser measure for critical thinking (average r = .160, var. = .010, k = 12, N = 1875, 95% C.I. ± .124) showed improvement. The studies using some other measure observed a positive improvement (average r = .215, var. = .007, k = 5, N = 782, 95% C.I. ± .150). The comparison of these two average effects demonstrates a larger average for nonWatson-Glaser measures (d = .80). If an argument is made about that scale for this data is that it underestimates the real effect.

The results using a cross sectional comparison of a communication skills experience to a control group were divided on the basis of measurement. The Watson-Glaser group demonstrated improvement (average r = .192, var. = .029, k = 10, N = 2105, 95% C.I. ± .303). The group of investigations using other methods of measurement observed an average correlation that was positive (average r = .226, var. = .013, k = 3, N = 290, 95% C.I. ± .123). A comparison of the two mean effects demonstrates

the same pattern as the longitudinal data, the Watson-Glaser measure demonstrates a smaller effect (d = .31).

The results indicate that the Watson-Glaser method of measuring critical thinking improvement produces smaller effects than other measures. However, the effect is consistent in direction, if not magnitude, to all the other measures. The evidence suggests the possibility of differential validity for scales but the consistent pattern indicates convergent validity for the measures.

Type of Communication Skill Experience

The longitudinal designs contained examined different types of skill experiences used in this analysis: (a) public speaking class, (b) argumentation class, and (c) competitive debate/forensics. The longitudinal design makes it possible to measure the improvement for each condition separately and compare effect sizes.

Participation in a public speaking improves the critical thinking skill of students(average r = .145, var. = .066, k = 6, N = 531, 95% C.I. ± .460).

Argumentation classes demonstrates improvement (t = 6.92) in critical thinking ability (average r = .129, var. = .012, k = 5, N = 549, 95% C.I. ± .107).

Participation in competitive forensics also demonstrated improvement in critical thinking across the investigations

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(*average r* = .203, *var.* = .010, *k* = 8, *N* = 1577, 95% C.I. ± .152).

The results indicate that all methods of communication skill improvement generate gains in critical thinking. The largest effect, however, was observed for competitive forensic participation when compared to a public speaking class (*d* = .40) or an argumentation class (*d* = 1.13).

The cross-sectional studies permitted a variety of comparisons. The first comparison considered when one group of participants has been part of a communication skill exercise and the change in critical thinking was compared to a control group. The average effect for this comparison demonstrated a larger gain in critical thinking ability for the communication skill exercise group (*average r* = .241, *var.* = .025, *k* = 10, *N* = 1526, 95% C.I. ± .270).

The comparison of competitive forensics to an argumentation or public speaking class demonstrates greater gain (*average r* = .271, *var.* = .015, *k* = 5, *N* = 455, 95% C.I. ± .190) for competitive forensics participants.

The participation in argumentation classes (or "enhanced" public speaking classes) when compared to normal public speaking classes finds argumentation classes generating greater improvements in critical thinking (*average r* = .364, *var.* = .022, *k* = 5, *N* = 362, 95% C.I. ± .206).

Conclusions

The average effects demonstrate that participation in public speaking, argumentation, and debate improves critical thinking skills. This is important because the findings illustrate that participation in public communication skill building exercises consistently improved critical thinking. Participation in forensics demonstrated consistently the largest improvement in critical thinking scores whether considering longitudinal or cross-sectional designs.

Unfortunately this summary cannot adequately address the concerns about the reliance on the Watson-Glaser measure of critical thinking. While other measures of critical thinking [Bursack (1961) used Sarett's, "How Do You Think Test?", Douglas (1951) used Johnson's (1942) measure of reflective thinking, Green & Klug (1990) evaluated written essays, Howell (1961) used the California Analogies and Reasoning Test, Tame (1958) used a combination of Bradley's Logical Reasoning Test, Henning's Problem Recognition Test, and Sarret's measure] were utilized by investigations, the bulk of existing data relies on the Watson-Glaser measure (in all of its forms). This limitation requires additional research that both develops and utilizes alternative devices. However, while the investigations primarily relied on a single measurement instrument, a comparison to the other measurement efforts produced consistently and larger effects. That is, the other devices demonstrated improvement in critical

thinking for all the public communication skill efforts which argues for the generalizability of the conclusion. The importance of this observation is that while dependence on the Watson-Glaser instrument as the primary measurement device creates the ability to undermine the results should any flaw or limitation exist in the instrument, current alternative measurement devices generate the similar conclusions. Future research should consider whether instrumentation could be improved or alternative instruments to Watson-Glaser contain similar flaws.

The impact of that improvement of critical thinking is illustrated in Table 5. Using Rosenthal's (1984) Binomial Effect Size Display (BESD) technique, a comparison can be made between those participating and those not participating in communication skill improvement programs/classes. Using BESD, the average effect ($r = .18$) indicates a 44% increase in the number of persons that score above the mean (the increase from 41% to 59%). This improvement in critical thinking ability indicates a large substantial positive influence of public communication training relating to critical thinking.

One issue that the forensics community needs to consider is the integration of the activity into the practices of departmental instruction. The central issue regarding communication, as a field, involves the fact that the process is an action necessary to living. Our field is a **lived** experience

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that every person enacts each day. Regardless of the area (organizational, interpersonal, rhetorical, mass, technological, small group, etc.,), there exists an aspect of performance and/or competence within that area which is a part of the ongoing theoretical and research tradition. One result, in the cross-sectional comparison, demonstrates the effect of public speaking may be improved by incorporating more aspects of argumentation into the curriculum.

The results demonstrate the value of forensics participation in improving critical thinking. The granting of academic credit for participation in forensics appears justified. The effects also point to the additional advantage that debate and forensics participation can provide to training solely in public speaking. The companion activities of engaging in both argument and counterargument, whether required in public speaking, discussion, argumentation, and/or forensics competition better prepare students to become full participants in society. This evidence provides a partial answer to charges of "anti-humanism" in the last few years (Roth, 1996).

This paper provides some evidence for meeting the calls of those for evidence of educational accountability. Forensic participation (as well as other forms of public communication instruction) can be justified on the basis of the critical thinking improvement offered. Forensics participation demonstrated larger effects for improvement in all conditions,

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particularly those calling for a comparison of the methods of instruction. These results provide important evidence to support the maintenance of forensics programs in an era of increased educational accountability, downsizing, and budgetary cutbacks.

Public communication (forensics, argumentation, public speaking), as a part of this larger endeavor, has a contribution to make both to the research, theory, **and** practice. The forensics community needs to contribute to the issues regarding how to improve the practice. While knowing that participation improves critical thinking is beneficial, the communication community needs to consider how to serve the participants using better and develop more effective approaches. Knowing that our contributions are positive should encourage confidence in our ability to experiment and to evaluate. The challenge is to integrate these experiences as a part of our overall curriculum rather than a view public communication skill training as a separate component. After all, improving critical thinking skills should benefit all students, regardless of the major or which class they next enroll.

Future research should consider the impact of public address skills courses on the ability to listen and organize. One would expect that forensics participation (in all its competitive and classroom forms) would generate positive outcomes along a whole host of skills. The ability to listen, organize, and take notes all provide a basis for success in a variety of endeavors.

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Future effort should target the particular activities that stimulate students to develop critical skills. The current results provide evidence for the effectiveness of the techniques but contribute little to the explanation of those effects.

The impact of public communication training on the critical thinking ability of the participants is demonstrably positive. This summary of existing research reaffirms what many exdebaters and others in forensics, public speaking, mock trial, or argumentation would support the conclusion: participation improves the thinking of those involved!

FOOTNOTES

[1]A comparison of this method with other methods of meta-analysis (Johnson, Mullen, & Salas, 1995) demonstrates that this method differs from methods used by Hedges and Olkin or Rosenthal. The article demonstrates little difference on the question of mean effect as demonstrated in Figure 1 (p. 101) or on issues of variability in Figure 3 (p. 103). The differences are found in the use of significance testing of the mean effect (see Figure 2, p. 102) and moderator prediction (see Figure 4, p104). The difference is that the Hunter and Schmidt technique does not improve in power as the sample size or number of studies increases. The purpose of the Hunter-Schmidt procedure was to develop a technique that was invariant to sample size, therefore it is consistent with the design of the technique to differ from methods that increase in power as sample size increases. Consequently, the estimates in this report are conservative with regard to interpretations of statistical significance. Hunter and Schmidt recommend that the use of the significance test be discontinued and reliance and confidence intervals be substituted. This report follows that recommendation.

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Table 1

List of Studies with Associated Statistical and Other Information

		Pre/Post			vs. Control			
Study	Date	r		N	r	r′	N	Measure
Allen	1995	.092	.096	104	.210	.229	138	Watson-Glaser
Baumgartner	1965	.354	.380	34	.286	.296	77	Watson-Glaser
Beckman	1956	.066	.066	293				Watson-Glaser
Beihl	1963	.083	.092	106				Watson-Glaser
Brembeck	1947	.196	.196	202	.136	.136	413	Watson-Glaser
Bursack	1961	.217	.275	328				Sarret Test
Colbert	1987	.303	.329	285	.342	.373	285	Watson-Glaser
Colbert	1995	.005	.006	148				Watson-Glaser
Cross	1971	.072	.078	136				Watson-Glaser
Douglas	1951	.392	.426	11	.512	.557	20	Combination
Frank	1967	.105	.111	103	.429	.451	206	Watson-Glaser
Green	1990	.671	.671	11	.449	.449	23	Graded Essays
Howell	1942	.207	.225	213	.051	.055	415	Watson-Glaser
Hurst	1961	.169	.180	87	.343	.367	157	California
Jackson	1961	.118	.126	123	.172	.179	249	Watson-Glaser
Ness	1967	.172	.180	164	-.045	-.049	331	Watson-Glaser
Smith	1942				.143	.155	34	Watson-Glaser
Tame	1958	.164	.164	309				Combination
Whalen	1991				.458	.475	49	Watson-Glaser

Note. The designation "r" indicates the uncorrected effect. The designation "r'" indicates the effect after correcting for error due to attenuated measurement, restriction in range, and regression to the mean. All averages are calculated using the effects after they have been corrected for the appropriate errors.

Table 2

List of Effects by Type of Longitudinal Comparison

		Pre to Post Change			
Study	Date	r	r'	N	Type of Experience
Allen	1995	-.035	-.038	37	Public Speaking
		.041	.044	32	Argumentation Class
		.257	.285	35	Forensics
Baumgartner	1965	.354	.380	34	Public Speaking
Beckman	1956	.066	.066	293	Argumentation Class
Beihl	1963	.083	.092	106	Public Speaking
Brembeck	1947	.196	.196	202	Argumentation Class
Bursack	1961	.217	.275	328	Forensics
Colbert	1987	.303	.329	285	Forensics
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Frank	1967	.105	.111	103	Public Speaking
Green	1990	.671	.671	11	Argumentation Class
Howell	1942	.207	.225	213	Forensics
Hurst	1961	.169	.180	87	Public Speaking
Jackson	1961	.118	.126	123	Forensics
Ness	1967	.172	.180	164	Public Speaking
Tame	1958	.164	.164	309	Forensics

Table 3

List of Study Effects and Coding when Using cross-sectional Designs

Study	Date	r	r'	N	Type of Comparison
Allen	1995	.133	.145	71	Control/Public Speaking
		.115	.125	69	Public Speaking/Argumentation
		.432	.470	72	Forensics/Public Speaking
		.245	.266	66	Control/Argumentation
		.327	.355	67	Forensics/Argumentation
		.486	.528	69	Control/Forensics
Baumgartner	1965	.286	.296	77	Control/Public Speaking
Brembeck	1947	.136	.136	413	Control/Argumentation
Colbert	1995	.342	.373	285	Control/Forensics
Douglas	1951	.512	.557	20	Public Speaking/PS + A
Frank	1967	.429	.451	206	Public Speaking/PS + A
Green	1990	.449	.449	23	Control/Forensics
Howell	1942	.051	.055	415	Control/Forensics
Hurst	1961	.343	.376	157	Control/Public Speaking
Jackson	1961	.172	.179	249	Public Speaking/Forensics
Ness	1967	.099	.113	227	Control/Public Speaking
Smith	1942	.143	.155	34	Public Speaking/PS + A
Whalen	1991	.168	.185	34	Argumentation/A + F
		.440	.458	32	Public Speaking/A + F
		.402	.417	33	Public Speaking/Argumentation

Table 4

Summary of Effect

	Type of Design	
	Cross Sectional	Longitudinal
average r	.176	.196
variance	.010	.028
k	17	13
N	2657	2395
95% CI	.124	.291

	Type of Measurement			
	Cross Sectional		Longitudinal	
	Watson-Glaser	Other	Watson-Glaser	Other
average r	.160	.215	.192	.226
variance	.010	.007	.029	.013
k	12	5	10	3
N	1875	782	2105	290
95% CI	.124	.150	.303	.123

	Effects when Comparing Types of Experience					
	Cross Sectional			Longitudinal		
	CS v. C	F v. A or PS	A/PS v. PS	PS	A	F
average r	.241	.271	.364	.145	.129	.203

variance	.025	.015	.022	.066	.012	.010
k	10	5	5	6	5	8
N	1526	455	362	531	549	1577
95% CI	.270	.190	.206	.460	.107	.152

Note. For type of skill comparison, CS = Communication Skill, PS = Public Speaking Class, C = Control, A = Argumentation Class, and F = Forensics

Table 5

Binomial Effect Size Display for Effects

Assuming a correlation of .18

	Percentage of Persons Scoring on Critical Thinking	
	Below the Mean	Above the Mean
Involved in Communication	41%	59%
Not Involved	59%	41%